Risk varies inversely with knowledge.

Irving Fisher, The Theory of Interest, 1930

Forum

Cell Signaling

Thousands of organic compounds are currently synthesized and released into the environment, often with only a minimum of regulation and no clear understanding of how chemicals interact with biological systems. The science of environmental medicine is now acting fast to respond to the need for such information by developing approaches to investigate these interactions.

Biologists are using advanced genetic and molecular tools, for example, to define the pathway by which an individual cell is poisoned. This new area of investigation, known as cell signaling, traces the interplay of proteins within a cell from the instant the cell is stimulated from outside, via its ion channels or membrane receptors, to the moment and method of its destruction. Cell signaling is seen as the key to understanding how basic cellular processes go awry in a variety of dysfunctions, including cancer.

Neurotoxicologists are now using the principles of cell signaling formulated by neurobiologists to study the fundamentals of environmental poisoning. For example, scientists are just now understanding what happened in cases of pesticide poisoning long assigned to the history books. One such event was the "Ginger–Jake" case, in which about 20,000 Americans were paralyzed in the 1920s from eating an extract of ginger called "Jamaica Ginger" that had been treated with an organophosphorus ester.

This ester belongs to a class of pesticides that produce a syndrome known as organophosphorus ester-induced delayed neurotoxicity (OPIDN), manifested by paresis in the legs, hands, and thighs that occurs days to weeks after exposure. In the later stages of OPIDN, symptoms of spinal cord injury such as spasticity and ataxia become evident.

Investigators now know that the crucial biochemical journey these organophosphides take starts at the cell's calcium channel, the protective gateway that limits entry of calcium into the cell. Calcium is involved in the regulation of a variety of nerve functions and is the ultimate target for many toxins; the death of a cell is often associated with the cell's inability to exclude calcium. Some toxins can also act by perturbing calcium signaling to the point that cell growth is inappropriately favored.

The pesticide in the Ginger–Jake case directly affects a second messenger in the signaling pathway known as calmodulin protein kinase II, an enzymatic catalyst that phosphorylates a number of cytoskeletal proteins. A recent experimental injection of an organophosphide in chickens resulted in such increased phosphorylation that the nerve cells' neurotubules and neurofilaments broke down and bound together. The result surprised researchers: they found a jumble of nerve tangles of the type seen in such degenerative diseases as Alzheimer's disease.

Research on cell signaling holds promise of unraveling the cellular basis of a wide variety of neurodegenerative dysfunctions and other adverse health effects that may be related to chemical exposure.

Volunteer Duty

Continuing a 36-year tradition, the Student Conservation Association (SCA) sent some 1500 high school, college, and older individuals streaming into 308 federal and state park sites nationwide last summer to learn about resource management through hands-on conservation projects.

More than 450 high school students worked on projects ranging from restoring damaged areas of Clearwater National Forest in Idaho to maintaining and repairing trails in Rocky Mountain National Park, Colorado. Approximately 1100 resource assistants, 18 years or older, worked as professional aides with SCA's cooperating agencies on projects including backcountry patrols in the Denali National Park and Preserve, Alaska, interpreting historical sites such as Fredericksburg and Spotsville National Military Park, Virginia, and monitoring wildlife and erosion control at Baxter State Park, Maine. Volunteers logged about 700,000 hours of volunteer time in the nation's parks this past season. In addition, the SCA also supported two international volunteer programs between the United States, Mexico, and Canada.

The SCA was begun in 1957 from the idea that public lands offer a superb training ground for individuals in conservation techniques of soil, water, vegetation, and wildlife. The SCA works closely with federal agency partners: the National Park Service, the U.S. Forest Service, the Bureau of Land Management, and the U.S. Fish

Lesley Schuler

Avian answers. Volunteers at Mattamuskeet National Wildlife Refuge in North Carolina study effects of mercury contamination on ospreys.